CALIBRATION PROCEDURE

FOR THE

MODEL 4400/230

DIGITAL MULTIMETER

November, 1968

CALIBRATION

1. INTRODUCTION

2. General. This calibration procedure eliminates the necessity of unsoldering and resoldering jumpers on the readout board of the 4400 series DMM. Any necessary maintenance should be done prior to calibration. Each calibration step in this procedure relies on the accuracy of the preceding step. Care should be taken to make each adjustment in the order that appears in this procedure.

3. EQUIPMENT.

4. General. The following equipment is required for DMM calibration, and is listed in order of use. The specifications listed are the minimum required to make the adjustment.

(a) Precision null detector/microvoltmeter with a minimum of 10 microvolts of resolution. For example, Fluke Model 845AR.

(b) Voltage calibrator variable from 0 to 1000 volts and a resolution better than 100 microvolts (at 1 and 10 volts). For example, Fluke Model 332A.

(c) Laboratory power source (AC) variable from 0 to 500 volts and 50 to 100 kHz with a resolution better than 100 microvolts (at 1 and 10 volts). For example, Optimation AC 104.

(d) AC/DC laboratory transfer standard for calibration of the AC source. For example, Holt Model 6 Thermal Transfer Voltmeter.

(e) Five digit DVM (optional). For example, Dana Model 5700 DVM.

(f) Standard resistors: 1K, 10K, 100K, 1 meg, and 10 megohm.

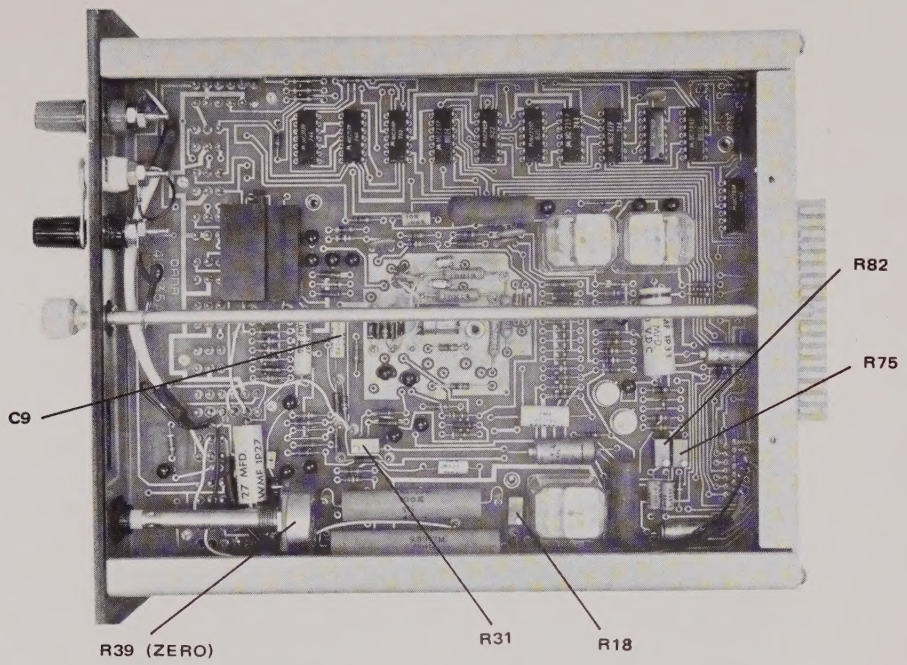

Figure 5.1 - Model 230 Isolator

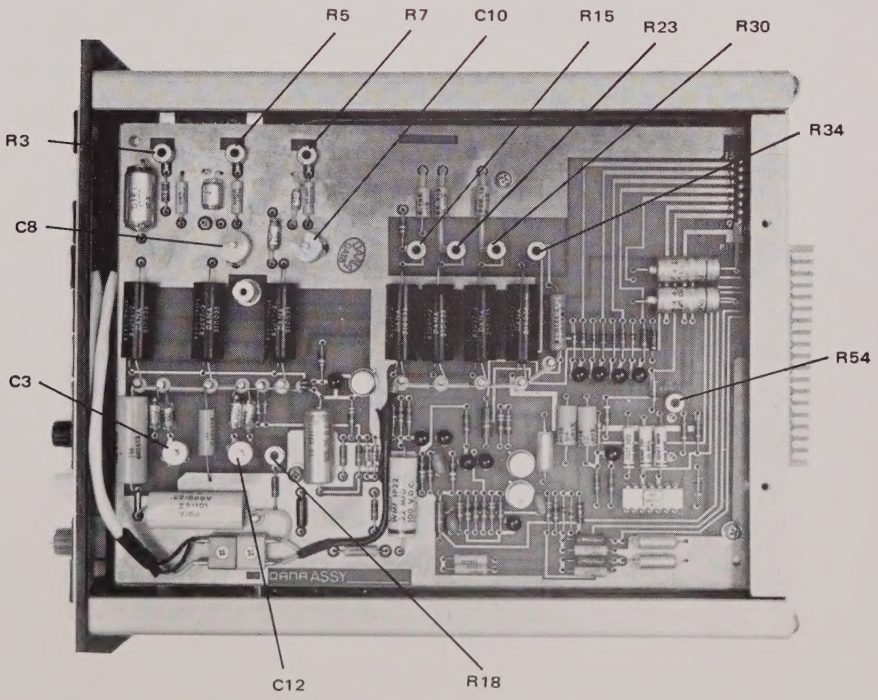

Figure 5.2 - Model 230 AC & Ohms Converter

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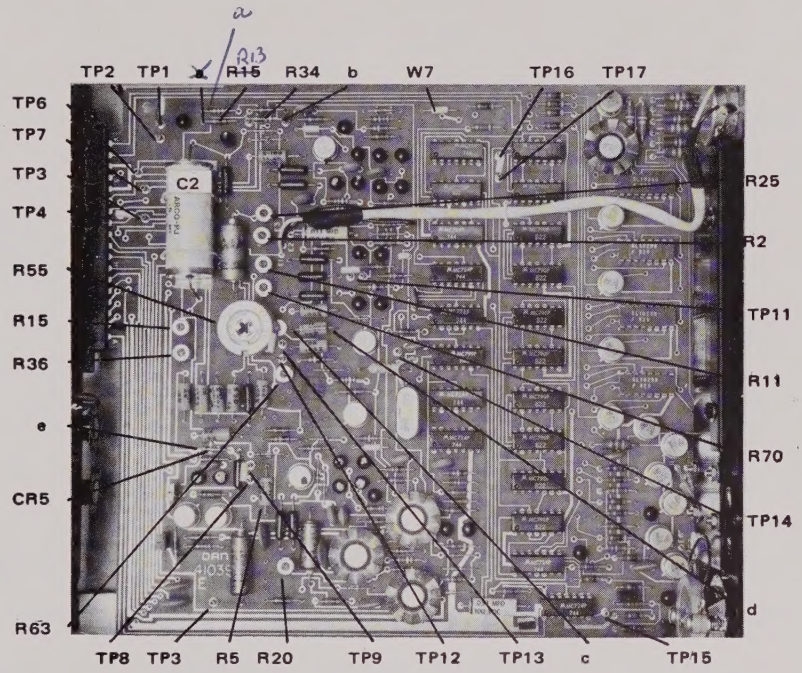

Figure 5.3 - Display Module

5. TOOLS

(a) Insulated blade-type calibration tool.

(b) No. 1 Phillips screwdriver.

6. OTHER

(a) 100,000 ohm 1/4 watt, 5% carbon resistor.

(b) 51,000 ohm 1/4 watt, 5% carbon resistor.

(c) 2 megohm 1/4 watt, 5% carbon resistor.

7. This section combines the calibration adjustments for the Digitizing and Display portion with the Accessory portion. If desired, one portion, the Accessory Module for example, can be calibrated separately, provided that the other portion is known to be calibrated. Each calibration adjust heading is clearly marked whether for Digitizing and Display or Accessory Module 230.

8. PREPARATION

(a) Remove both the top and bottom covers of the DMM. Set the Model 4400 OFF-ON-HOLD switch to ON and allow at least 30 minutes for the instrument to warm up.

9. ADJUST RAMP GENERATOR ZEROS (Display Module)

(a) Remove Isolator Module

(b) Connect a jumper between TP4 (Ramp Input) and TP6 (Reference Common).

(c) Connect a 10K ohm resistor across capacitor C2.

(d) Connect a jumper from the junction of R13 and the base of Q3 (point a on figure 5.3) to TP6.

(e) Connect the positive side of the precision calibrator source in series with a 2 megohm resistor to the junction of R33 and R34 (point b). Connect the low side of the source to TP6.

(f) Connect the positive input of the microvoltmeter in series with a 51K ohm isolation resistor to the same junction of R33 and R34. Connect the low side to TP6.

(g) Adjust the calibrator voltage for a reading of zero $\pm$ 30 microvolts.

(h) Connect the positive input of the microvoltmeter in series with the 51K ohm isolation resistor to the top of C2 (figure 5.3). Retain the low side at TP6.

(i) Adjust the voltage zero R25 for a reading of zero $\pm$30 microvolts.

(j) Move the microvoltmeter positive input to TP11.

(k) Adjust the current zero R11 for a reading of zero $\pm$ 30 microvolts.

(l) Verify results of steps f, h and j to establish optimum zeros.

(m) Do not remove jumpers or voltages until after paragraph 10.

10. ADJUST NULL DETECTOR ZERO (Display Module)

(a) Connect a jumper between TP1 and TP6.

(b) Attach another jumper from the junction of R56 and R57 (point c) to TP6.

(c) With the low side of the microvoltmeter still attached to TP6, connect the positive input to the summing node junction of R57, R58, and R59 (point d).

(d) Adjust the current zero, R63, to read zero ± 30 microvolts.

(e) Remove the jumper from point c to TP6.

(f) Remove all other jumpers, resistors and voltages.

(g) Reinstall Isolator Module.

11. ADJUST INTERNAL REFERENCE (Display Module)

(a) Set the Voltage Calibrator to the reference voltage value recorded on the zener serial tag mounted on the back of the display shield.

(b) Connect the positive side of the voltage source to the cathode side of CR5 (point e) and the positive input of the microvoltmeter to TP6.
CAUTION: Avoid shorting cathode of CR5 to adjacent straps.

(c) Connect the negative side of the calibrator to the low side of the microvoltmeter and tie their case connections together.

(d) Adjust the zener calibration potentiometer R36 for a microvoltmeter reading of zero ± 10 microvolts.

(e) (optional method)

Connect the DVM common lead to TP6 and the input lead to TP7. Adjust the potentiometer R36 for a DVM reading equal to the value recorded on the zener serial tag (DVM reads - polarity).

(f) Remove the leads to CR5 and TP6.

12. DC ISOLATOR ZERO (Accessory Module)

(a) Select 0.1 volt scale.

(b) Connect a jumper across C9 (.1 μf capacitor, see figure 5.1).

(c) Connect microvoltmeter between TP2 (+) and TP6 (-) on Display module (see figure 5.3).

(d) Adjust front panel ZERO control (R39) for a microvoltmeter reading of 0 ± 200 microvolts.

(e) Remove short across C9.

(f) Place a 10 megohm resistor across the input terminals.

(δ) MOMENTARILY SHORT INPUT TERMINALS

(h)(g) Adjust the current zero pot (R31) for a stable reading of all zeros on the readout.

I) REPEAT STEPS g AND h UNTIL a STABLE READING of ALL ZEROS IS OBTAINED on the READOUT

13. ADJUST DMM POLARITY (Display Module)

(a) Select the 10 volt range. Connect the DMM input terminals to a DC voltage source and set the voltage source output to -.002 volts.

(b) Adjust the null detector voltage zero control R70 for a display reading bouncing between -0.001 and -0.002 volts.

(c) Set input to +0.002 volts. Adjust R20 (voltage zero control for the auto polarity) for a display reading bouncing between 0.001 and 0.002 volts.

14. ADJUST POSITIVE AND NEGATIVE GAIN (Display Module)

(a) Set the calibrate control R1 on the front panel to its mechanical center.

(b) Set the voltage source output to -9.9990 volts.

(c) Adjust the rough calibration control R2 for a DMM display reading of 9.9 volts. Adjust R1 for a display reading bouncing between -9.998 and -9.999.

(d) Reverse the polarity of the voltage source (+9.9990).

(e) Adjust the positive polarity gain control R55 for a display reading bouncing between 9.998 and 9.999 volts.

(f) Repeat steps a through d for interaction between controls.

15. ADJUST VOLTAGE DIVIDER (Accessory Module, Figure 5.1).

(a) Set the voltage source output to -0.10000 volts and the DMM range to .1.

(b) Adjust the millivolt gain control R82 for a display of -.10000.

(c) Select the 1 volt range and set the voltage source to -1.00000.

(d) Adjust the 1 volt gain control R75 for a display of -1.0000.

(e) Select the 1000 volt range and set the voltage source to -1000.00.

(f) Adjust the 1000 volt divider control R18 for a display of -1000.0.

(g) Apply -100V to the input and verify that readout indicates -100.00 volts.

16. ADJUST CALIBRATE TEST (Display Module)

(a) Select a DMM range of 1.

(b) Manually depress and hold in the calibration switch.

(c) Adjust R15 for a dipslay reading of -1.0000.

17. ADJUST AC VOLTAGE DIVIDER (Accessory Module, Figure 5.2)

(a) Connect DMM input terminals to the AC voltage source.

(b) Select AC function and autorange.

(c) Set AC source output to 1 volt at 400 Hz.

(d) Adjust the 1 volt, 400 Hz control (R18) for a DMM display reading of 1.0000.

(e) Set AC source to 500.00 volts at 400 Hz.

(f) Adjust the 500 volts, 400 Hz control (R3) for a DMM display reading of 500.00.

(g) Repeat steps c through f as necessary.

(h) Set the AC source to the following series of AC voltages and adjust the appropriate controls as called out on the bottom plate of the Accessory Module.

VOLTS RMS	FREQUENCY	ADJUST
100	400 Hz	R5
10	400 Hz	R7
500	10 kHz	C3
1	10 kHz	C12
(Repeat above four steps as necessary)		
100	10 kHz	C8
10	10 kHz	C10

18. OHMS CONVERTER RANGE ADJUSTMENT (Figure 5.2).

(a) Set FUNCTION to KILOHMS and RANGE to AUTO.

(b) Connect input to a 1000 - ohms standard and adjust R54 for readout of 1.0000 (plus any zero offset present with test leads shorted).

(c) Connect input to a 10 - megohm standard and adjust R34 for readout of 10000.

(d) Connect input to a 10 - kilohm standard and adjust R15 for readout of 10.000.

(e) Connect input to a 100 - kilohm standard and adjust R23 for readout of 100.00.

(f) Connect input to a 1 – megohm standard and adjust R30 for readout of 1000.0.

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